A maternity roost of the Large-eared Pied Bat *Chalinolobus dwyeri* (Ryan) (Microchiroptera: Vespertilionidae) in central New South Wales Australia

Michael Pennay

New South Wales Department of Environment and Climate Change, PO Box 733 Queanbeyan NSW 2620.

Email michael.pennay@environment.nsw.gov.au

ABSTRACT

A maternity roost of the Large-eared Pied Bat *Chalinolobus dwyeri* was found in a sandstone cave near Coonabarabran in central NSW approximately 200 km south west of Copeton where the only other known maternity roost of this species has been found. The roost was first discovered on the 15 November 2001 and visited another four times to August 2004. Between 14 and 40 adult females were observed to carry twin young over 3 separate summers, the young were estimated to been born in the first half of November and 15 adults were also observed in the cave in late winter. Observations of the cave indicated it was well insulated from external temperature fluctuations and showed signs of long term use by the bats.

Key words: Large-eared Pied Bat, ***Chalinolobus dwyeri,*** maternity site, breeding, births, pups, roost, cave, colony, conservation and threats.

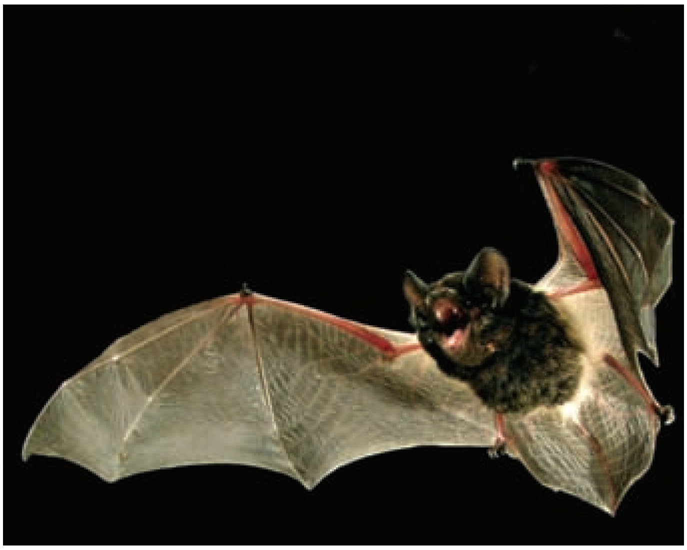

Figure 1. Large-eared Pied Bat *Chalinolobus dwyeri* flies slowly but with extremely high maneuverability, its relatively broad wings combining low loading with high aspect ratio (Dwyer 1965).

Photo, M. Pennay.

Introduction

The Large-eared Pied Bat *Chalinolobus dwyeri* is a threatened species; it is listed as vulnerable on the IUCN red list (VU A2c) and under both the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 and the NSW *Threatened Species Conservation Act* 1995. The species' habits are very poorly known, in particular knowledge of its breeding and maternity behaviour. The only information available on maternity behaviour of the species is based on observations from a roost located in a mine tunnel at Copeton, New South Wales (NSW) flooded by the Copeton Dam in 1976 (Dwyer 1966). *Chalinolobus dwyeri* maternity sites remain elusive. Since Dwyer's observations of the Copeton tunnel 40 years ago there have been no new observations of maternity roosts or behaviour of the species published, despite the occasional capture of lactating females during surveys in several locations throughout its range (Hoye 2005).

To clarify if any unreported maternity roosts exist, one hundred and ninety Australian bat research scientists, professionals, land managers, wildlife carers and interested community members were contacted by email via the Australasian Bat Society and asked if they had ever found, or knew of, any maternity roosts of this species. The survey revealed anecdotal reports of four unique communal roosts, however their use as maternity sites remains unconfirmed. All reported communal roosts were from the north western slopes of NSW, three from caves in the Pilliga Sandstone region and one from a mine at Woods Reef (now collapsed). There have been no reports of maternity roosts found in the Queensland (B. Law, H. Parnaby, P. Spark, I. Gynther, M. Murphy, J. Molloy, M. Schulz, A Fawcett, Pers. Comm.).

Location

This roost was found on a private property north west of Coonabarabran in central NSW. The locality is characterised by a geological transition zone, the landforms are predominantly colluvial and alluvial, derived by the erosion of the Jurassic Pilliga sandstones typical of the southern Pilliga. A number of small exposed volcanic basaltic intrusions and extrusions interrupt the Pilliga sandstones; these are derived from the volcanic activity between 20 and 13 million years from the Warrumbungle ranges immediately to the south (NPWS 2003). The landscape features a sandstone plateau dissected by large escarpments with many small caves and overhangs and fertile valley floors. This combination of landforms is restricted regionally. Most of the valley floors in the region have been cleared for agriculture, however some of the valley floors on the property where the roost was located have not been cleared or had regrown. Uncleared valley floors can also be found along Dandry Creek in the southern parts of Pilliga Nature Reserve adjoining the property.

Mean annual rainfall based on rainfall records from the property over the past 20 years is 750mm. The long term average from Coonabarabran (approx 10 km east) from 1879 -2007 is 739 mm; the range is variable 321-1596 mm. The highest rainfall months are January and February in the summer period (BOM 2007).

The roost was located within a sandstone cave situated mid-slope on the north westerly aspect of a hill. Vegetation cover on the hill slope immediately surrounding the cave consists of an open woodland dominated by Red Stringybark *Eucalyptus macrorhyncha* and Brown Bloodwood *Corymbia trachyphloia*, with Scribbly Gum *E. rossii* and scattered Grass Trees *Xanthorrhoea* sp.. A woodland of White Box *E. albens*, Rough-barked Apple *Angophora floribunda* and Barradine Gum *E. chloroclada* occurs in the more fertile areas along the valley floor approximately 40 m below the cave entrance.

The roost is close to the western limit of the species' range in NSW, with no verified records of the species occurring west of the Pilliga sandstone (Atlas of NSW Wildlife, Australian Museum specimen register, CSIRO National Wildlife Collection and Australian Bird and Bat Banding Scheme databases, accessed March 2006).

The cave

The cave entrance is aligned with the slope facing north-west, approximately 3.5 m wide and 50-60 cm high. The entrance leads horizontally into the hillside, opening into a compressed ellipse (obovate, to use leaf terminology) shaped chamber approximately 15 m wide and 1-1.5 m at its highest points (Figure 2). The ceiling is sandstone and the floor sandy, scattered with eroded flakes of sandstone ceiling fragments (Figure 3).

The main chamber of the cave, where the bats were observed roosting, is in the twilight zone, partially lit by diffused light coming through the entrance, although the actual indentations on the ceiling used by the bats are completely dark (marked in Figure 2). Two small tunnels 15 -20 cm high by 30–50 cm wide continue at floor level beyond the back wall deeper into the hillside, although how far they continue underground is unknown.

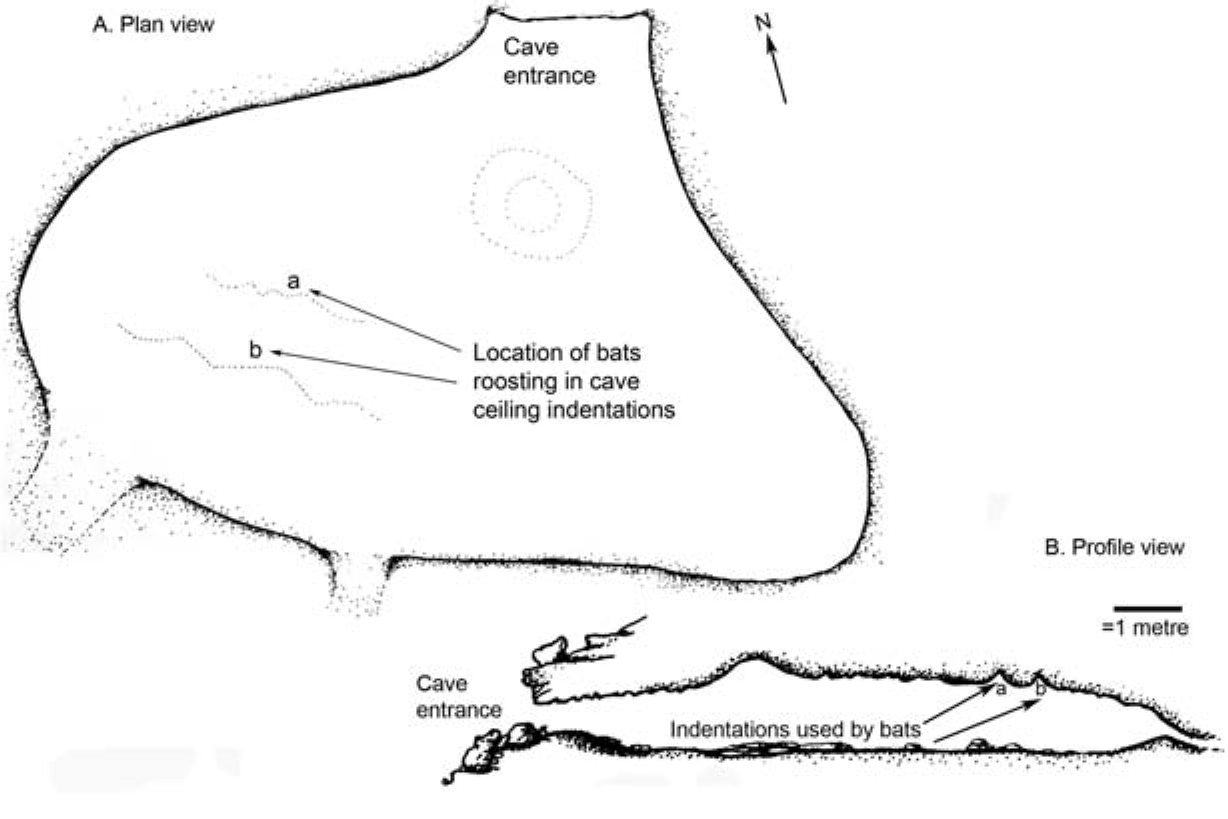
A. Plan view
Cave entrance
N
a
b
Location of bats roosting in cave ceiling indentations
B. Profile view
=1 metre
Cave entrance
a
b
Indentations used by bats

Figure 2. Scale sketch map of the cave showing plan and profile views Illustration, M. Pennay

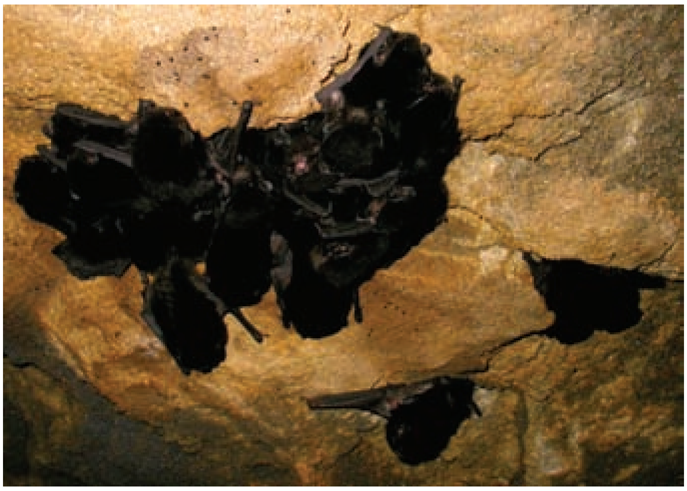

Figure 3. Photograph of one cluster of bats in the *Chalinolobus dwyeri* maternity colony described, taken 16/1/04: Note the wear on sandstone and bat fly casings indicating long term use.

Photo, M. Pennay.

Observations

All observations were made during daylight hours whilst the bats were roosting, and were initially made during a vertebrate survey being undertaken in the area. Additional observations were made opportunistically on subsequent visits to the area to investigate subfossil fauna remains found in other caves on the property. All counts were based on estimates as the bats were not touched or handled during visitations.

On the 15th November 2001, 14 adult females each carrying two young pups were found in two clusters occupying separate indentations in the cave ceiling (general area marked in Figure 2). The pups were small and hairless; one dead pup was found on the floor immediately below one cluster and is lodged at the Australian Museum (field tag no. 52535). A digital thermometer/ hygrometer with twin sensors (Thermoworks RT817E, range -50 to +70°C, 20-99%RH, resolution 0.1°C/1%, accuracy ± 1°C/ 3%) was left in the cave, one sensor was placed on the cave roof adjacent to the bats the other on the floor. The cave was visited again 4 days later on the 19th of November 2001. On this occasion approximately 20 adult females carrying twin young were found in a single cluster in another crack in the ceiling nearby. The young were still small and hairless but were estimated to be 1-3 weeks old based on changes in size over the 4 day period between observations. A second dead pup was found on the floor of the cave below the cluster on this visit. The cave provided a highly insulated environment with a mean fluctuation of only 3.2 °C between minimum and maximum temperatures (3°C on the floor 3.4°C on the ceiling) over the period the 15th and 19th of November. The recorded temperature in the cave ranged from 15.5°C. to 18.5°C on the floor, and 16.1°C to 19.5°C on the ceiling. In contrast, the outside air temperature over the same period fluctuated by 30.4°C (minimum 0.8°C, maximum 31.2°C) (BOM 2001). The difference in recorded minimum of the cave ceiling over the period was 15.3°C warmer than outside minimum, and the maximum 10.9°C degrees cooler than outside maximum. The relative humidity was also more stable within the cave, ranging between 51% and 76%, compared to between 23% and 89% outside over the same period (BOM 2001).

The cave was visited again on three additional occasions. In mid December 2002, approximately 20 adult bats were found in a single cluster in a different indentation in the roof. Most adult bats within the group had a pair of lightly furred juvenile bats roosting with them. On the 16th of January 2004, approximately 40 adult bats were roosting in 2 clusters very close to each other, one cluster was in an indentation in the roof and one cluster in a crack in the ceiling approximately 25 cm away. Each adult bat was accompanied by two juveniles roosting beneath them. The juveniles were fully furred and capable of flight, but were still visibly smaller than adults. On the 16th August 2004, 15 adult size bats were seen in the cave all roosting in the same location.

Discussion

These recent observations from Coonabarabran share many similarities with Dwyer's original observations from Copeton in the summers of 1961-62 and 1962-63 and suggest that despite a distance of 200 km between Copeton and Coonabarabran and a period of 39 years between observations that many of the behaviours observed are typical of the species habits.

Timing: The most notable similarity is the timing of birth and age of young. Dwyer (1966) noted in October 1962 that females were 'conspicuously pregnant' and that by 10th December the same year they had all given birth at which time he estimated their age to be 3-4 weeks old (ie. born between 12th -19th November). In 2001 at Coonabarabran, juveniles observed on the 19th November were estimated to be 1-3 weeks old (ie. born somewhere between the 29th October and 12th November). Observations from Coonabarabran in mid December 2002 of juveniles covered in dense short black

Table 1. Summary of bats observed.

Date	Est. Number adults	Est. Number young	Age of young	Clusters
15/11/01	14	<27	Bald	2
19/11/01	20	<40	Bald	1
Dec 2002	20	<40	Lightly furred	1
16/1/2004	40	Many	Fully furred – sub adult size	2
16/8/2004	15	Nil	Nil	1

hair also match with Dwyer's notes from 10th December 1962 that all juveniles were fully furred by this date with the exception of the smallest bat found. This strongly suggests that C. *dwyeri* in NSW give birth in the first half of November.

Twin young: Another similarity in the observations at both colonies was the number of pups raised by each female, on all three occasions where pups were seen at Coonabarabran most adults had twin young, although it was also noted in November 2001 that at least two pups died at a very early age. Dwyer (1966) noted in December 1962, 22 juveniles for 13 lactating females and a single dead pup; a mean litter size of 1.8. These observations combined confirm that *C. dwyeri* in NSW gives birth to twins, although some pups (at least 7- 10%) perish in the first few weeks.

Regular roost use: This roost at Coonabarabran was occupied and breeding took place over the three consecutive summer seasons 2001-2002, 2002- 2003, and 2003-2004. Anecdotal observations by the property owner, wear of sandstone ceiling around the colony and presence of bat fly (Nycteribiidae or Streblidae) pupae on the cave roof close to clusters all suggest that the cave was used regularly by the bats (Dick and Patterson 2006; Figure 3). Dwyer (1966) also noted that the roost at Copeton was used for approximately 10-15 years based on anecdotal observations and guano. The bats at Copeton showed roost fidelity with banded bats returning in consecutive years, although the bats did not use the Copeton roost in the last 2 summers of his study 1963-64 and 1965-66. The bats at Coonabarabran were not marked, so roost fidelity cannot be established, but it is appears that maternity roosts of *C. dwyeri* are used regularly by the same individuals over consecutive seasons.

Differences

A number of observations from this roost near Coonabarabran differ from the Copeton roost described by Dwyer (1966). The roosts are physically different: the Coonabarabran roost being a naturally formed cave as opposed to an artificial mine tunnel. The geology also differed, with this roost in sandstone substrate as opposed to granite at Copeton. The roost cave at Coonabarabran was also much smaller, the main chamber approximately 10 m (d) x 15 m (w) x 1.5 m(h) compared with Dwyer's (1966) mine tunnel which was 10 ft (3.05 m) high and 350 ft (106.6 m) long.

Number of adults: Generally the number of adult bats in the colony was 14 – 20, compared to 0 -18 bats at Copeton. However, on January 16th 2004 there were approximately 40 adults accompanied by twin young, an estimated total number of around 110 individuals. This is far greater than the maximum number found by Dwyer (1966) (37 individuals -15 adults and 22 juveniles) at Copeton. There are many potential explanations for the difference, for example it may be possible that naturally occurring geological features provided a better environment for roosting or that the quality of foraging habitat and available food resources surrounding the roost affects numbers. It may also be that maternity aggregations usually number 14-20 females and the group seen in January 2004 consisted of 2 separate groups of females, one or both that had moved from another cave nearby.

Winter use: A group of 15 adult bats used this cave in late winter (August 2004). At Copeton, the bats vacated the mine tunnel between April and August (Dwyer 1966). This difference may relate to differences in the thermal properties of natural sandstone cave compared to the mine tunnels or other unknown reasons.

Other cave roosting bats: The region supports two other cave dependent species (*Vespadelus troughtoni* and *Rhinolophus megaphyllus*, see Appendix 1) also believed to be at the western limits of their range in NSW. *Vespadelus troughtoni* is also listed as vulnerable under the *Threatened Species Conservation Act* (NSW) 1995. A colony of 30 – 50 *V. troughtoni* was observed on two occasions roosting in a disused shearing shed on the property and a pair were observed roosting in a small sandstone rock shelter on one occasion. Law and Chidel (2007) measured the microclimate of several *V. troughtoni* roosts in NSW. Both cave/overhang (20-25°C) and shed roosts (diurnal mean = 30°C) of *V. troughtoni* were substantially warmer than that recorded in this study for *C. dwyeri*, suggesting the species have differing roost requirements and that the *C. dwyeri* may be less tolerant of high roosting temperatures.

Conservation

Recent habitat modeling based on surveys in the southern Sydney region (DECC 2007) suggest that *C. dwyeri* is largely restricted to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys (presumably for foraging habitat). Survey work in the Brigalow Belt South bioregion of NSW and species habitat modeling by Pennay and Gosper (2002) generally supports this hypothesis. Although *C. dwyeri* were also captured in other geological substrates with escarpments and caves, they were most frequently associated with box gum woodlands or creek flats.

Box gum woodlands have been extensively cleared for grazing and cropping in the sheep and wheat belt of NSW (Prober and Brown 1994). For this reason, Box-gum woodlands are listed as 'Critically endangered' nationally under the *Environment Protection Biological Conservation Act* 1999 and as an 'Endangered Ecological Community' in NSW under the *Threatened Species Conservation Act* 1995. (DEC 2007b).

The co-occurrence of suitable escarpment geological features with fertile woodlands is naturally very restricted on the western slopes of NSW, occurring only in a small number of locations such as the south-eastern Pilliga /Warrumbungle area around Coonabarabran and the Mount Kaputar foothills east of Narrabri. This naturally restricted combination of habitat features has been further constricted by extensive clearing of woodlands on the NSW western slopes (Prober and Brown 1997; Briggs *et al*. 2007).

The amount of habitat available for C. *dwyeri* or how much it has been reduced is unknown, however recent suggestions that it may require the interface of fertile woodlands and suitable cave-forming geology strengthen the case for its listing as a vulnerable species at risk (DECC 2007). The species was previously thought to be well protected in the large sandstone areas of the Blue Mountains and Wollemi National Parks, however its preferred habitat is now suspected to be much more restricted (DECC 2007).

Many of the caves inspected on this property had been used by feral goats *Capra hircus*, as indicated by a deep layer of goat scats, and strongly smelling of goat urine. In contrast, the cave containing the roost had not been used by goats. The only signs of use by other vertebrates were old scats of Brush-tailed Rock-wallaby *Petrogale penicillata* and more recent scats of echidnas *Tachyglossus auceatus*. Presumably the low height of the entrance (50 cm height) has deterred goats from entering the cave.

The relatively low ceiling of this cave (1-1.5 m) puts most of the ceiling within reach of foxes and cats. Direct observations of either predator killing microbats are rare in Australia, however they have been suggested as potential threats to many Australian bats (Duncan *et al*. 1999; Hoye 2005; DECC 2007). In an account of fox predation on the cave-dwelling bat, *Miniopterus schreibersii* and *M. australis* over the period 1961 – 1963 from Yessabah near Kempsey NSW, Dwyer (1964) noted bats were being taken from a low arch 3 ft (91 cm) high and calculated that an average of 12.5 bats per month and 150 per annum were being killed. Given the small colony sizes observed for C. *dwyeri* and the fact they sometimes roost within reach of foxes, it would be possible for a fox to consume an entire colony in a little as 2-4 months.

These published observations of a second maternity roost of C. *dwyeri* add to the scarce information known about the species and they also illustrate the paucity of our understanding of its behaviour and ecological requirements and highlight that additional investigation is much needed.

Acknowledgements

I would like to thank Jane Judd, Milton Judd, Chris Turbill, Rebecca Drury, David Read, Alex Dudley, Jane Bastin-Sikimeti, Susan Rhind and Ken Aplin for poking around in these caves with me. Brad Law, Harry Parnaby, Phil Spark, Ian Gynther, Michael Murphy, Jamie Molloy, Martin Schulz, Kylie Madden, Glenn Hoye, Gregory Little and Adam Fawcett who all shared information regarding possible maternity roost sites. Finally I would also like to thank Chris Turbill, Martin Schulz and Brad Law for reviewing the manuscript and providing useful comments on how it could be improved.

References

BOM. 2001. Australian Bureau of Meteorology, Coonabarabran Weather Station Data for November 2001. Sheet DC02D 064008 999999992043845.

BOM. 2007. Australian Bureau of Meteorology Climate Statistics for Australian Locations, Coonabarabran web page. http://www.bom.gov.au/climate/averages/tables/cw_064008_All.shtml Accessed 27/4/2007 21:15.

Briggs, S.V., Seddon, J. and Doyle, S.J. 2007. Structures of bird communities in woodland remnants in central New South Wales, Australia. *Australian Journal of Zoology* **55:** 29–40.

Carl, W.D. and Patterson, B.D. 2006. Bat flies - obligate ectoparasites of bats. Part 2 p179- 194 in *Micromammals and Macroparasites From Evolutionary Ecology to Management*. Edited by S. Morand, B.R. Krasnov and Poulin R. Springer Japan.

DECC. 2007.*Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region: Volume 2 Species of Conservation Concern and Priority Pest Species*. Joint Project Report. Sydney CMA, DECC (NSW). Sydney

DECC. 2007b. Threatened Species Website. Box-Gum Woodland profile http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10837 Accessed 28/4/2007 14:09.

Dick, C.W. and Patterson, B.D. 2006. Bat flies - obligate ectoparasites of bats. Pp.179-194 in Micromammals and Macroparasites From Evolutionary Ecology to Management, edited by S. Morand, B.R. Krasnov, R. Poulin. Springer-Verlag, New York.

Duncan, A., Baker, G.B., and Montgomery, N. 1999. *The Action Plan for Australian Bats*. Environment Australia Canberra.

Dwyer, P. D. 1964. Fox predation on cave-bats. *Australian Journal of Science* **26:** 397-398.

Dwyer, P. D. 1965. Flight Patterns of some Eastern Australian Bats. *Victorian Naturalist* **82:** 37-41.

Dwyer, P.D. 1966. Observations on *Chalinolobus dwyeri* (Chiroptera: Vespertilionidae) in Australia. *Journal of Mammalogy* **47:** 716-718.

Hoye, G.A. Fly By Night Bat Surveys Pty Ltd. 2005. Recovery plan for the large-eared pied bat *Chalinolobus dwyeri*. Queensland Parks and Wildlife Service, Brisbane.

Law, B.S. and Chidel, M. 2007. Bats under a hot tin roof: comparing the microclimate of eastern cave bat (Vespadelus troughtoni) roosts in a shed and cave overhangs. *Australian Journal of Zoology* **55:** 49-55.

NPWS. 2003. *Pilliga Nature Reserve Plan of Management*. NSW National Parks & Wildlife Service, Hurstville.

Pennay, M., and Gosper, C. 2002. *Brigalow Belt South Stage 2 Vertebrate Fauna Survey, Analysis and Modelling Projects*. Resource and Conservation Division, Planning NSW. Sydney.

Prober, S.M, and Brown, A.H.D. 1994. Conservation of the Grassy White Box Woodlands: Population Genetics and Fragmentation of Eucalyptus albens *Conservation Biology* **8:** 1003-1013.

Appendix I

Local bat fauna

Other bat species observed in the Ukerbarley and Dandry Creek gorges surrounding the roost during this period were:

Chocolate Wattled Bat *Chalinolobus morio*

Gould's Wattled Bat *Chalinolobus gouldii*

Lesser Long-eared Bat *Nyctophilus geoffroyi*

Gould's Long-eared Bat *Nyctophilus gouldi*

Greater Long-eared Bat (South-eastern form) *Nyctophilus cf. timoriensis*

Eastern Horseshoe Bat *Rhinolophus megaphyllus*

Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris*

Inland Broad-nosed Bat *Scotorepens balstoni*

Eastern Cave Bat *Vespadelus troughtoni*

Little Forest Bat *Vespadelus vulturnus*